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Education Department Bulletin

Published fortnightly by the University of the State of New York

Entered as second-class matter June 24, 1908, at the Post Office at Albany, N. Y., under the act of July 16, 1894

No. 509 ALBANY, N. Y. DECEMBER 15, 1911

New York State Museum

JOHN M. CLARKE, Director

Museum Bulletin 154

GLACIAL GEOLOGY OF THE SCHENECTADY QUADRANGLE

BY

JAMES H. STOLLER

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Director State Museum and
State Geologist

STATE HALL, ALBANY, N. Y.

New York State Education Department
Science Division, May 22, 1911

Hon. Andrew S. Draper LL.D.
Commissioner of Education

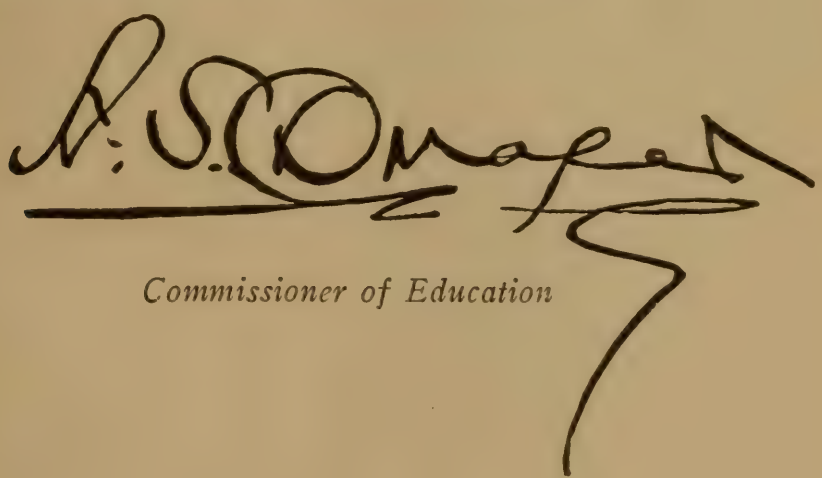
DEAR SIR:

I beg to communicate to you herewith for publication as a bulletin of the State Museum a manuscript entitled *Glacial Geology of the Schenectady Quadrangle,* which has been prepared for this division by Professor J. H. Stoller.

Very respectfully
JOHN M. CLARKE
Director

STATE OF NEW YORK
EDUCATION DEPARTMENT
COMMISSIONER'S ROOM

Approved for publication this 24th day of May 1911



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GLACIAL GEOLOGY OF THE SCHENECTADY QUADRANGLE

BY

JAMES H. STOLLER

The bedrock of the area comprised in the Schenectady topographic sheet consists of the sandstones and shales of the Lorraine formation. The present report has to do with the materials overlying the bedrock, that is, the soils and earthy materials of whatever kind, whether fragmentary or more or less compacted, including clays, sands, gravels, hardpan, loose stones and boulders. These surface materials (excepting such additions as are of recent origin, as stream alluvium and blown sand) were brought to their present location by the agency of moving ice or by the flooded waters resulting from the melting of the ice. They are deposits of the Pleistocene, or Glacial period.

The distribution of these deposits, especially those laid down during the epoch of flooded waters, was determined largely by the general topography of the region, as due to the slope and surface features of the bedrock. A brief description of the more important of these topographic features will therefore first be given.

TOPOGRAPHY DUE TO ROCK SURFACES

THE MOHAWK CHANNEL

The area under consideration is crossed by the Mohawk river which pursues a zigzag course across the southern half of the sheet. Where the river enters the area, at its western edge, its valley is

broad and bounded by rocky slopes rising, on the north side, to the Glenville hills which attain an elevation of upward of 1000 feet and, on the south, to hills of still greater height. This portion of the valley, therefore, exhibits the features characteristic of a river valley of mature development.

The valley further widens toward the east forming a broad basin, filled with a thick mass of gravel and sand, through which the river has cut its way dividing into several streams which unite at the site of the old city of Schenectady. Rocks are exposed only on the northern slope of this basin, its southern boundary being a bluff of clay and sand forming the edge of the great sand plain that stretches southeast from Schenectady to Albany. There is evidence, however, that there is a rocky bluff, buried by the sand and clay deposits, lying to the south of the surface bluff. The borings made in 1899 by the United States Board of Engineers on Deep Waterways[1] show that near South Schenectady the bedrock stands at an elevation of 320 feet and that it then abruptly falls off to 210 feet beneath the valley of the Poentic kill, a southern tributary to the Mohawk basin, about three-fourths of a mile to the north, beyond which rock was not reached. How far eastward the rock-bluff extends is not known. The streams which enter the basin from the south flow on clay bottoms, not having cut their beds deep enough to expose rock. Eastward from Schenectady, near the margin of the sand-covered area, rock shows at the level of 340 feet.

Below Schenectady the valley gradually narrows and rocks outcrop on the slopes on both sides of the river.

Just east of Aqueduct there is an abrupt change in the features of the valley. Here the flood plain of the river comes to an end and the stream enters a narrow gorge bounded by nearly vertical walls of rock. This portion of the Mohawk valley, as will be more fully explained farther on, has been formed since the melting of the ice of the Glacial period.

Where the gorge ends near Vischer Ferry the valley again widens, forming a basin, but no rocks are seen on its slope until near Dunsbach Ferry where they appear on both sides of the river. Borings made by the Deep Waterways Survey[2] met with no rock at a depth of 65 feet below the surface of the basin.

[1] Deep Waterways Report, pt 1, p.540, plate 30; House Doc. v. 71, 1900.
[2] *Op. cit.* p.522.

THE BALLSTON ROCK-CHANNEL

The name *Ballston Channel* has been given by Woodworth[1] to the topographic feature described by him as follows: "From near Schenectady an old rock-channel trends north north-eastward by Ballston toward Saratoga."

In the present account this rock-channel will be limited to the broad troughlike depression, extending from near East Line, in the northern part of the sheet, in a general direction about 20 degrees west of south and joining the Mohawk valley west of Aqueduct. A low divide, at about 300 feet A. T., occurs in the bottom of the trough at about one-third of its length from the southern end. North of this divide lies Ballston lake, a narrow body of water, occupying the deepest portion of the channel. The outlet stream of the lake flows sluggishly northward for a mile and then turning eastward descends to the Round lake basin, described below. South of the divide the drainage is to the Mohawk river by Alplaus creek which enters the channel from the west through a narrow defile cut into the rocks. The altitude of Ballston lake is 285 feet; the slopes of the channel on either side of the lake rise to upward of 400 feet A. T. The width of the channel taken across the southern end of the lake is a little less than a mile. The floor of the channel, especially its middle portion and on either side of the divide, consists of bare rocks or rocks thinly covered with detritus. Rocks are exposed on both slopes of the channel, especially in the Ballston lake region.

As stated by Woodworth,[2] this rock-trough has been determined partly by structure. On the slopes at either side the rocks are generally horizontal in position. In the floor of the trough west of the lake, however, there is a line of outcrop following the axis of the channel, where the rocks are nearly vertical in position. This outcrop is best seen near the station Timeson on the trolley line about one and a half miles north of Ballston Lake station. Outcrops of vertical or highly inclined strata parallel with the axis of the trough occur farther to the north. They are well shown near where Mourning kill turns northerly in its course; and again east of the same stream, along the road, near the northern edge of the map.

THE ROUND LAKE DEPRESSION

About four miles east of the Ballston rock-channel there is a large depression, somewhat circular in outline, in the bottom of

[1] Ancient Water Levels, N. Y. State Mus. Bul. 84, 1905, p.75, 76.

[2] *Op. cit.* p.76.

which lies Round lake. The floor of this depression is largely covered with materials of Glacial age but on the slopes, at their lower levels, there are frequent exposures of rock. Rock appears only a few feet above the level of the lake on the northern side where the rock-valley, through which the outlet stream of Ballston lake flows, opens into the depression. Exposures of rock appear at several places on the road, recently macadamized, running southeasterly from Maltaville. On the south side of the depression, rock is seen on the banks of the stream below the pond at Usher.

Concerning this depression and that in which lies Saratoga lake, four miles to the north, with an elevation of 204 feet, Woodworth says: "It seems probable that Round and Saratoga lakes are unfilled depressions marking the site of an old valley west of the present Hudson gorge." J. H. Cook, in a paper read before the American Association for the Advancement of Science in 1908, gives additional facts indicating that an old rock-channel, now covered, extends southerly from the Round lake region, intersecting the valley of the Mohawk below Vischer Ferry.

THE GLENVILLE ROCK BASIN

I give this name to the extensive depressed area bounded to the west by the slope of the Glenville hills and on the north and east by the more gradual and broken slope of the Charlton hills. The basin is drained by two streams: Alplaus kill, which lies at the base of the Charlton slope, emerging from the basin at High Mills where it enters a gorge that opens into the Ballston channel; and a creek, unnamed on the topographic sheet, that skirts the base of the Glenville hills and joins the Alplaus creek in its course through the southern end of the Ballston channel. Both these streams receive small tributaries. One of these marks the extension of the basin to the south where it opens into the Mohawk channel.

For the most part the rock underlying this basin has but a thin covering of soil. The Alplaus kill traverses lacustrine deposits, as will be later explained, but the streams draining the rest of the basin show frequent exposures of rock.

MODIFICATIONS OF ROCK TOPOGRAPHY PRODUCED DURING THE PLEISTOCENE PERIOD

GENERAL ICE EROSION

The yielding nature of the shales and argillaceous sandstones was favorable to extensive abrasion by the moving ice sheet. The extent to which the rock surfaces were generally modified by this cause can not well be determined, but in some localities evidences of ice erosion are conspicuous.

In the Glenville hills region there are many terracelike stretches with bedrock of sandstone or shaly sandstone, detached fragments of which are scattered on the surface. It is inferred that these fragments of rock were produced by the process of plucking, or loosening of joint blocks by moving ice. The leveled surfaces may have resulted from the more ready removal, by ice abrasion, of the less resistant shales that are interstratified with the layers of sandstone.

In the same region there is a valley which is judged to have originated by ice erosion. It is indicated by the contour lines of the sheet and lies a short distance west of the road which runs southwesterly at a distance of about one and a half miles east of Town House Corners. The valley is in the form of a narrow troughlike depression about one and a half miles in length and five or six hundred feet in diameter. It is excavated in the bedrock; outcrops of shaly sandstone, horizontal in position, show on both slopes. In cross section the valley is U-shaped and its depth, taken near the middle portion, is estimated at 40 feet. The valley opens at its southern end in the general depression of the Mohawk channel. The bottom is not occupied by a stream and there is a divide in the middle portion which seems to render improbable the view that the valley as a whole is of stream origin. The slopes are clean-cut, evenly rounded and closely parallel. No glacial scratches were found in the vicinity but the direction of the valley coincides well with that of the striae found elsewhere.

GLACIAL SCRATCHES

In general the bedrock where exposed is worn and broken at the surface, because of weathering. In considerable portions of the area, therefore, glacial scratches are infrequent or lacking. They have been observed in the following localities:

1 North of the city of Schenectady on surfaces of sandstone in

quarry near the Troy branch of the New York Central & Hudson River Railroad, 42° west of south.

2 In a quarry about a mile to the east of the former, 22° west of south.

3 Two miles north of Rexford Flats on sandstone exposed at the roadside, 38° west of south.

4 At the 600-foot level on a branch of road running north from Hardin's crossing, on the Amsterdam trolley line, on sandstone exposed at roadside, 35° west of south.

5 Near the western margin of the sheet at an elevation of 780 feet on the road running east-west from the north-south road that passes through Town House Corners, on sandstone at roadside, 57° west of south.

The readings as above given are magnetic north.

PROBABLE AGENCY OF ICE IN THE FORMATION OF THE BALLSTON CHANNEL

Evidences that the Ballston channel is an old rock-channel have been referred to above. It presents, however, a number of features which indicate that the old stream-formed valley was deepened and widened by ice erosion during the glacial period. The general shape of the valley in cross section conforms rather to the type of an ice-made valley. The bottom is broad and the slopes where the valley is most fully developed, along the southern half of Ballston lake, are somewhat steep and smoothly planed. It will be noted that the

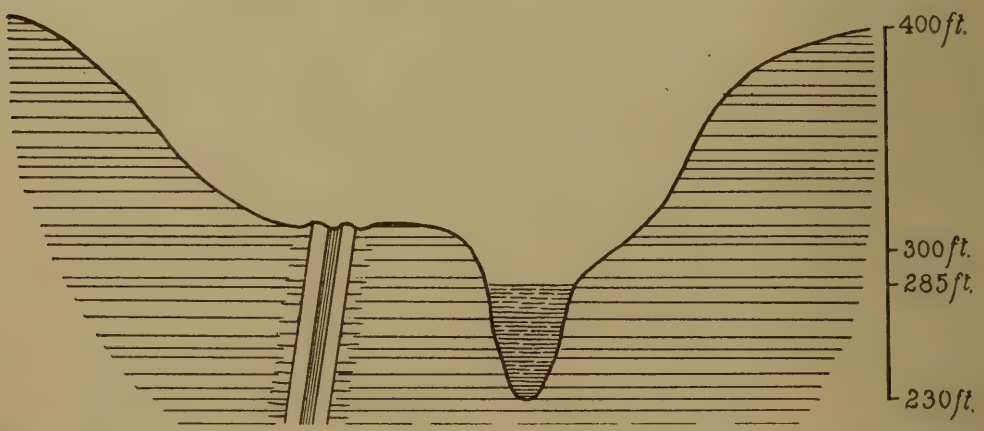

Fig. 1 Diagram showing topography and rock structure as seen in section across Ballston hannel at about one mile north of the southern end of Ballston lake. Vertical scale 100 feet to he inch. Horizontal scale one-fourth of a mile to the inch

lake does not lie in the middle line of the trough, but to the eastern side. West of the lake the shore, for the most part rocky, rises somewhat sharply to a level of about 35 feet above the surface of

the lake; beyond this the floor of the channel is continued to the base of the slope. Its surface shows many minor elevations and depressions. The elevations are in part due to the vertical position of the strata which in places appear as ridges where beds of sandstone alternate with the softer shales. Moreover, on both sides of the lake the rocks are horizontal in position. Thus erosion appears to have taken place more destructively across the faces of the rocks than on their edges. Glacier ice, with its inclosed fragments of hard rock, would more probably produce this condition than would running water. In this connection the somewhat remarkable depth of the lake at its southern end merits consideration. A sounding taken by the writer at a point about 400 feet from the southern end of the lake showed a depth of 109 feet. Another sounding taken at a point about half a mile from the southern end showed a depth of 55 feet. This narrow and deep depression somewhat abruptly terminating at the head of the lake, suggests the gouging action of glacier ice rather than river erosion.

The general direction of the axis of the channel, coinciding well with the direction of the glacial striae of the general region, is in harmony with the view here expressed. The deductions made from these data are as follows:

It is highly probable that a preglacial stream heading to the north followed the course of the present Ballston channel, finding its bed in the line of the vertical outcrops of rock, and joined the Mohawk near Schenectady. The valley made by this stream was in glacial times scoured out and enlarged by ice erosion. At a later time as will be explained farther on, after the melting of the ice, powerful currents, diverted from the flooded Mohawk, swept northward through the open channel, producing some further erosive effects and finally, with the passing of the flooded epoch, leaving the channel in its present features.

THE MOHAWK GORGE

As already stated the Mohawk river beginning near Aqueduct occupies a channel which has been formed in postglacial times. The evidences of this may be briefly stated as follows: An abrupt change in the features of the valley begins just west of Aqueduct. From a broad valley, with (on the north side) a gentle slope and wide flood plain, there is a transition to a narrow, deep valley or gorge. The cliffs on either side, below Aqueduct, are nearly vertical and about 140 feet in height. There are no high, gently sloping hills

or uplands, with crests parallel to the river, such as are characteristic of the valley west of Schenectady. There is no flood plain and there is little deposit in the bed of the stream. The stream flows on bedrock and the island in the river north of Vischer Ferry is of rock. The process of excavation of the bed is still going on; there is a fall of 25 feet from the State dam at Aqueduct to a point about one mile west of Vischer Ferry, a distance of about five miles.

These features abundantly justify the conclusion that the gorge is of a late geological origin. It does not follow, however, that the section of the Mohawk valley above the head of the gorge extending westward to Schenectady, or somewhat beyond Schenectady, belongs to the old Mohawk channel. There are evidences favorable to the view that this section is in origin a part of the Ballston channel. The latter merges with the Mohawk channel west of Aqueduct. It seems probable that the stream from the north which in preglacial times coursed through the Ballston channel joined the Mohawk at a point near Schenectady. When the Mohawk was shifted from its

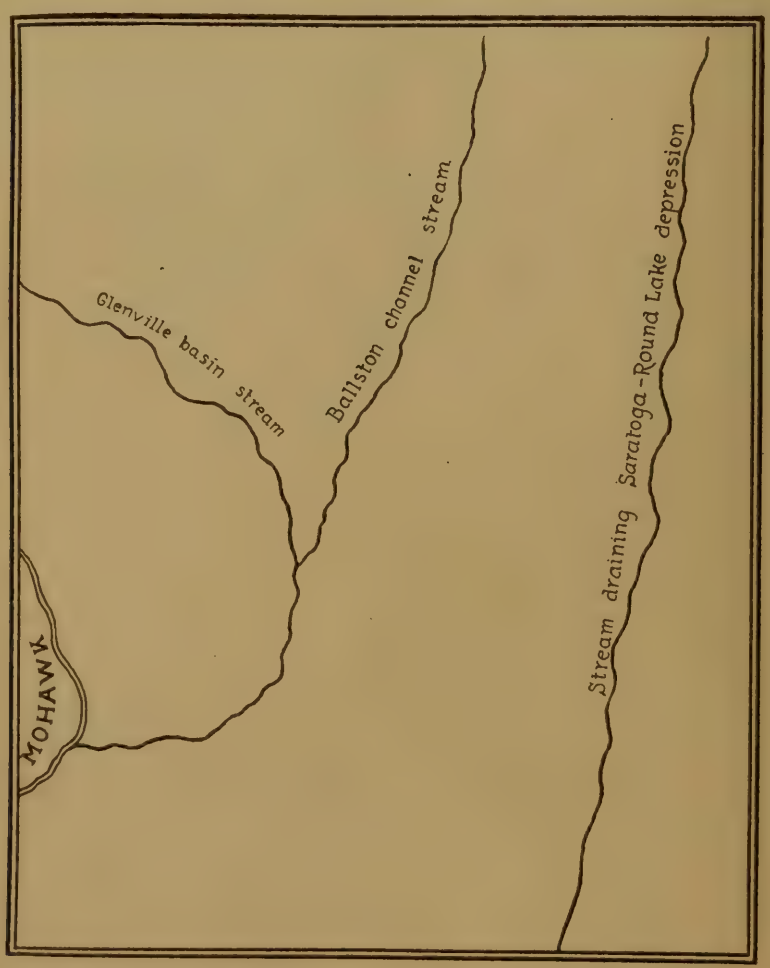

Fig. 2 Sketch map showing probable preglacial drainage of the area of the Schenectady quadrangle

The Mohawk river at Aqueduct, three miles east of Schenectady. At this place the river enters a postglacial gorge, the wall of which, 140 feet high, is dimly shown in the middle background of the picture.

course, due to the filling up of its channel, beginning near Schenectady, with deposits of Glacial age, it took possession of this portion of the Ballston channel as far as Aqueduct and from there on cut a new channel in the rocks.

The location of the buried channel of the preglacial Mohawk from near Schenectady eastward has not been determined. The borings already referred to indicate that there is a depression in the bedrock in the locality north of South Schenectady. Along a line extending from the bank of the river, at a point about three-fifths of a mile west of the Schenectady waterworks to a point near South Schenectady no rock was struck. Unfortunately the borings were made only to a depth of 195 feet above sea level, so that the vertical extent of the depression was not determined.

SURFACE DEPOSITS

Having noticed the more general topographic features of the area as determined by the underlying rock surfaces and the modifications of these features by erosion during the glacial period, we may describe the deposits or surface materials of Pleistocene age.

UNMODIFIED TILL

By this is meant the materials derived from the ice sheet, whether left from the bottom or dropped from the ice at the time of melting, which have undergone little or no disturbance since they were originally deposited. They are distributed generally over the upland regions of the area and in smaller patches, at lower levels, where the land rose above the surface of the waters of the flooded epoch. About one-half of the surface of the Schenectady sheet is covered by till.

The thickness of the till varies from a few inches to upwards of a hundred feet. As far as observed the thickest deposits lie in the hills southeast of the Mohawk gorge below Aqueduct. Borings made for water near the residence of Mr W. T. Hanson, near the station Knolls on the Troy branch of the New York Central Railroad, penetrated 130 feet of earthy materials before striking bedrock. A section of the till at this place is afforded by the grading of a roadway running from the base of the hill, where bedrock is exposed, to the summit. It consists in the lower portion largely of compact dark clay, inclosing large and small boulders and without appearance of stratification. Higher up the mass is of looser texture and the relative amount of sand is greater.

A fine exposure of till may be seen near the point where the macadamized road running east of Round lake crosses the eastern margin of the sheet. The materials here are of the typically heterogeneous character and include pockets of evenly stratified coarse sands and gravels, mostly in cross-bedded arrangement, indicating turbulent and shifting local currents. A thickness of about 80 feet is exposed.

In the Glenville hills region and in the floor of the basin adjacent to these hills the till is generally of slight thickness. To a large extent the streams have worn their channels to bedrock and there are frequent exposures of rock in the roadside gutters. In the fields fragments of detached sandstone rock are widely scattered. A broad area of thinly covered rocks extends southerly from the

plain which lies at the foot of the Glenville hills to the Mohawk channel. The materials of the till of this area are chiefly clay and fragments of shale and shaly sandstone, evidently derived from the local rocks. Cobbles and boulders of gneissic and quartz rock occur.

Drumlins. There are a number of hills of a well-defined drumlin type. The most conspicuous of these is that in the town of Glenville crossed by the east-west road north of Alplaus. The hill is of an elongated elliptical shape, about one mile in length and one-quarter of a mile in diameter. There is an exposure of bedrock in the road west of the hill; taking this as the level of the base of the hill its thickness at the summit is about 40 feet. The direction of the long axis corresponds closely with that of the glacial striae observed elsewhere. A partial section of the hill is afforded by the cut made in grading the road and reveals the till nature of the material.

Another drumlin of smaller dimensions but similar features occurs one and a quarter miles to the west.

The hilly region in the town of Niskayuna crossed by the road that runs south from Aqueduct presents hills of till of drumlinlike outlines. The group of hills south of the village of Niskayuna, the highest of which has an elevation of 500 feet, is probably of this type.

Morainic hills. In the vicinity of the village of Burnt Hills the topography is marked by hills of irregularly rounded or moundlike forms separated by basin-shaped depressions or wide intervening hollows. They are most typically developed in the area southeast of the village toward the Ballston channel. Owing to their moderate size they are not indicated by the contour lines of the sheet. Of the materials that enter into the composition of these hills the amount of gravel and sand is conspicuously large. In places, as observed at the surface, little else is visible. The gravel consists of coarse sand, hard, worn pebbles and small cobbles and worn fragments of shaly rock. In the locality here referred to no exposure sufficient to determine whether the materials are stratified in arrangement was found; but farther to the west beyond the road that runs south from Burnt Hills a cutting was found in which the materials showed definite stratification. Also at the side of the road that runs eastward from Burnt Hills there is a sand and gravel pit that shows a layered arrangement. The area in which gravel abounds extends to the west and southwest and is cut by the Alplaus gorge. South of the gorge the fields are strewn with coarse gravel and cobblestones.

It seems warrantable to interpret these features as due to accumulations of glacial debris along the margin of the ice-front and indicating a pause in the recession of the ice sheet. It is certain that a thick mass of materials was thrown down west of High Mills, obstructing drainage and giving rise to a glacial lake (Alplaus lake) described below. This obstructing mass was in continuity in east-west direction with the group of hills possessing the features of kames, just described. The facts seem to warrant the view that a recessional moraine was formed extending from near Ballston Lake station westward beyond High Mills. The surface features of this moraine are still evident in its eastern portion; the western portion is evidenced chiefly by the sand and gravel materials and their arrangement.

To avoid multiplying distinctions in mapping, I have included the Burnt Hills locality within the area designated "glacial till more or less covered and mingled with . . . glacio-fluviatile deposits . . ."

KAMES

A notable group of hills answering to the description of kames occurs in the township of Clifton Park about one mile southeast of Groom Corners. The topographic forms which have been termed mound-and-basin or knob and kettle, are characteristically exhibited. The largest of the kettles is designated by depression contours on the topographic sheet. A relief of 60 feet between the bottom of the kettle and the top of the hill immediately to the south is indicated by the contour lines.

All of the hills have rounded or moundlike outlines but with much irregularity of shapes. Some of them are elongated and with somewhat steep slopes. The longest of the hills trends in a northeast-southwest direction. It may represent a deposit made by a subglacial stream or stream emerging from the edge of the glacier.

The materials of composition of the hills are fairly distinctive in character. There is a predominance of gravel, consisting of small and large pebbles and cobbles together with course sand and fragment of the local bedrock. No exposures were found sufficient to determine the arrangement of the materials.

There is a ridgelike accumulation of gravel just west of the large kettle which suggests heaping effects against an ice-block.

Thé Lake Albany deposits. A large part of the area of the Schenectady sheet is covered with deposits of clays and sands which are continuous with similar deposits lying to the east and which have been interpreted by Woodworth and others as deposits of delta origin made in the extensive body of glacial waters known as Lake

Morainic hills, southeast of the village of Burnt Hills

Albany. Southward from Schenectady lies the sand plain region, the materials of which are described by Woodworth[1] as "the most extensive deposits of this nature (delta) in the Hudson if not also in the Champlain valleys." A portion of this plain, developed in its characteristic topographic features — a generally flat surface marked by many low hills and ridges of sand — occupies the southwestern portion of the Schenectady sheet. Eastward of this lie the hills of till in the town of Niskayuna which, however, are largely covered by blown sand. Farther to the east and south of the Mohawk an area of sandy clay broken by hills of till and dissected by streams extends to the eastern boundary of the sheet. On the eastern side of the sheet a broad and unbroken area of sands extends from the Mohawk channel northward to the Round lake depression. North of the depression the sands again appear forming a plain lying between the Round lake basin and that in which Saratoga lake lies. The margins of this plain are deeply gullied by the small streams tributary to the lakes.

These areas of sands and clays are continuous, except as broken by the Mohawk channel and the obvious water course across the Round lake region. The inference that they are deposits made in one body of water is scarcely open to question. They constitute, however, deltas built into Lake Albany from different sources and under varying conditions. The deposits near Schenectady were brought down by the Mohawk during the flooded or Iroquois stage of that river. The Mohawk delta thus formed became confluent to the south and east with deposits made from waters moving in the general valley of the Hudson. The deposits in the eastern part of the Schenectady sheet both north and south of the Mohawk, belong largely, if not wholly, to the Hudson valley accumulations. A reservation is made in recognition of the possibility that, after the gorge below the Aqueduct began forming, the Mohawk deposited sediments in the basin below Vischer Ferry.

In addition to the areas above described there are others of less extent composed of similar materials and believed to be deposits made in Lake Albany. Two of these are crossed by the northern border of the sheet. Their surfaces are on the same general level as that of the Malta plain to the east and they are evidently portions of the same mass cut off by water courses. A more isolated area occurs west of the southern part of the Ballston channel in the town of Glenville. This presents the same features as to materials,

[1]Ancient Water Levels, N. Y. State Mus. Bul. 84, 1905, p. 130.

topography and elevation as the Albany deposits elsewhere. The source of the materials is believed to have been from the Alplaus drainage basin to the northwest. It is true that this portion of the lake was in communication with the main body of its waters through the open Ballston channel near where the latter joins the Mohawk channel. Woodworth has expressed the opinion that at the time the Mohawk delta was making south of Schenectady, no deposits were made in Lake Albany north of the Mohawk because that area was then covered with ice. I have found nothing incompatible with this view. As the ice retreated to the north, the Alplaus basin became open earlier than the Ballston channel to the north and the part of Lake Albany in question became silted up by inflows from the Alplaus basin.

RELATION OF THE LAKE ALBANY DEPOSITS TO THE TILL

Till underlies the Lake Albany deposits generally, as they occur on the area of the Schenectady sheet. Where streams have cut through the sands and clays, boulders lie in their beds. In a few instances the stream bottoms are in part boulder clays. For example, the stream that flows into Saratoga lake from the Malta plain region has its bed, in a part of its course, on a compact blue clay. The same stream, where it emerges from the Albany deposits onto the flat swampy area bordering the lake, shows blue clay in its banks and boulders in its bed.

The stream that flows into Round lake from the west has likewise cut through the Lake Albany deposits and exhibits both boulder clay and boulders in its bed.

As already stated the streams that flow northerly from the sand plain near Schenectady have their beds on the Albany clays, not having cut through this deposit. Poentic kill farther to the west has a boulder-strewn bed and on its bank, in a railroad cutting near the new station of South Schenectady (just off the edge of the sheet), till is exposed underlying the lacustrine deposits. In a boring made by the Deep Water Survey[1] on the sand plain, near South Schenectady, cobblestones were found as the surface of the underlying rock was approached.

Similar observations with regard to the stratigraphic relation of the Lake Albany deposits to the till were made in the other localities, where the deposits are distributed, as described above.

Elevation. The elevation of these lacustrine deposits varies some-

[1] Deep Waterways Report, p. 540, House Doc. v.71, 1900.

what in the different localities. The Mohawk river has cut into the materials of the sand plain at Schenectady forming the crescentic line of bluff bordering the Mohawk flats. This bluff consists of evenly stratified clays below grading into stratified sands above. These have been partially disarranged by weathering at the summit but a little south of the top of the bluff horizontally stratified sands and fine gravels were observed in cuttings made in grading a street. According to the contour lines the elevation at this place is not less than 350 feet. The general elevation of the plain farther to the south is slightly lower but it has clearly suffered from wind denudation.

In the southeast portion of the sheet east and south of Watervliet Center the surface of the clay deposits is at a lower elevation than that of the plain south of Schenectady. Crossing the river to the north the deposits, largely of sand at the surface, rise to a gradually higher altitude. North of Round lake on the flat sand tract east of Malta the 380-foot contour lines are shown. In the Ballston Spa area, at the northern edge of the sheet, horizontally stratified sands at 380 feet elevation were seen in an excavation made in the construction of macadamized road.

Regarding the elevation of the Mohawk delta deposited in Lake Albany, Woodworth says:[1] "The average elevation of the surface from Albany southward at the brink of the gorge (Hudson) is now 200 feet. The surfaces rise northwestward to an elevation of about 350 feet near Schenectady." The data above reported show that there is a continuation of this rise as far north as the northern edge of the Schenectady sheet.

COMPOSITION AND ARRANGEMENT OF THE DEPOSITS

1 **Near Schenectady.** As already stated the Lake Albany deposits near Schenectady consist of clays grading into sands. As a general condition the clays predominate up to the level of 300 feet. The grading of streets has afforded opportunity to observe these clays, in their upper levels, through about 100 feet of exposure. They are of dark color, very fine grained, highly plastic when wet and cut with smooth shining surface. When exposed they become slightly indurated so that their edges at a distance appear like shale rock with even horizontal stratification. If the dried layers are cut with a knife fine laminations are shown. They weather from a dark to a gray color.

[1]Ancient Water Levels, N. Y. State Mus. Bul. 84, 1905, p. 130.

At the higher levels the clays become sandy and at the top of the bluff, at a level of 340 feet, the materials are predominantly sand. Transitional stages occur, where thin layers of clay, often yellowish in color, are interstratified with layers of fine sand or sandy clay. The materials of the bluff at the higher levels are well exposed farther to the west, toward South Schenectady. In a cutting made in grading the new line of the Delaware & Hudson railway, in that part of the bluff at the foot of which Poentic kill flows, a thickness of about 50 feet of sand is exposed. There is also a deep and broad sand pit along the old line of the railroad east of South Schenectady. Here the sand is for the most part coarse and at the top of the pit on the south side, approaching the 360 foot level, fine gravels occur. In places there are evidences that the materials were laid down in turbulent waters, as shown by cross-bedding and the occurrence of pockets of dark-colored, angular-grained sands.

In regard to the mineral composition of the sands microscopic examinations of samples collected in several different localities showed that quartz is the predominant constituent and that feldspar and a dark mineral, probably magnetite, rank next in abundance. The grains are generally of irregularly rounded form, though some are angular.

It is evident from these data that, after Lake Albany had formed, for a long time the Mohawk currents brought down and deposited in the lake near where Schenectady is now situated great quantities of clay sediments. The source of these sediments was chiefly the argillaceous rocks (already largely disintegrated by glacial erosion) which prevail in the drainage basin of the river. They were deposited under comparatively tranquil and constant conditions as shown by the even horizontality and the fineness of the laminations of the clays. This was due to the fact that the force of the currents had already been largely spent, the river entering the lake some miles to the west.

At a later time sediments composed chiefly of sand were brought into the lake and deposited upon the clays already laid down. These sands were evidently derived from the gneissic and other crystalline rocks of the Precambric formations. As the southern slopes of the Adirondack region became freed from ice the streams tributary to the Mohawk from the north contributed their load of sediments and these coarser materials were borne to Lake Albany. The powerful currents swept the sands far out into the lake, building a broad delta which eventually merged with similar accumulations formed in the Hudson channel.

With the subsidence of the waters of Lake Albany the sands be-

Plate 3

Lake Albany clays in excavation for new high school on Nott terrace, Schenectady

came the surface materials of the sand plain. At the same time the currents of the Mohawk, now confined to their channel, cut powerfully into the western edge of the mass of deposits. Gradually the basin at Schenectady, bounded by the bluff which still parallels the course of the river, was eroded out.

To what depth below the level of the present surface of the basin the mass of deposits extends is not known. I am informed by Mr J. L. Fitzgerald, City Engineer of Schenectady, that a boring was made under his direction, in connection with locating a site for a gas tank, at a point near Villa road, some 400 feet from the foot of the bluff, and that a depth of 50 or 60 feet of sands and clays was penetrated. The sands are described by him as "quicksands," consisting of rounded grains. He states that the sands occurred in layers, with thin partings of clay. I am also informed by Mr B. B. Steers, manager of the Schenectady Gas Company, that a boring was made near the site of the present gas works on South Center street and 150 feet of sand was penetrated and no rock was struck. The boring was tubed for the purpose of obtaining water but the supply was meager and the well was abandoned.

It would appear from these data that the rock basin near Schenectady is of considerable depth. It seems probable that this depression was already partly filled with deposits when the epoch of delta-building in Lake Albany began.

2 **The Round lake region.** In the Round lake region clays are exposed on the floor of the depression and in places on its slopes. The level to which the clays rise is about the same as in the deposits near Schenectady. In a cutting where the road entering Round Lake village from the west descends the hill, horizontally stratified dark clays are seen at approximately the 300 foot level. They are overlaid by sandy clays grading into sands. The clays appear in several places, on the opposite side of the depression, in cuttings made in grading the macadamized road. West of Maltaville, beyond the creek, where the road ascends the hill, a very interesting section is presented. At the base (at about the 220 foot level) a thickness of about 12 feet of dark evenly stratified clays are shown. Above this are 3 feet of fine-grained, yellowish clayey material, not exhibiting stratification. Overlying this and unconformably with it is a layer about 4 feet thick composed of sand, gravel and small cobbles.

There is another section similar to this on the same road half a mile to the south.

It is evident that in this locality the clays have been subjected to

erosion and that the coarse gravel was deposited upon the eroded surface. (The middle layer evidently consists of weathered clays.) Assuming that the upper layers of the clays were originally at the same level here as on the west side of the depression, about 70 feet of clay have been removed by erosion.

Reserving for a moment the further interpretation of the section we may notice other features of the Round lake depression. On ascending the hill above the section just described, going toward Malta, the surface material is till up to about 340 feet elevation. Beyond that are the sands of the Malta plain rising to the level of 380 feet. Thus in ascending the hill from the creek we cross successively stratified clays, a deposit of gravel, till, and a thick surface bed of sands. The floor of the depression is largely composed of till but with a broad area of clays along Anthony kill. There is a ridge of till extending from the site of Round Lake village southeasterly across the floor of the basin. South of Round lake this ridge rises to the height of 100 feet above the level of the clay area, forming a dome-shaped, boulder-strewn hill. To the west of this ridge there is a low-lying swampy tract the surface materials of which are varied — clay, sand, till and vegetable debris entering into their composition. North of the clay flat along Anthony kill, till is the predominant material of the floor. The slopes surrounding the depression at the higher levels are everywhere sand except where the rock valley of the inlet stream of the lake opens into the depression.

All of these features become clearly understood by the following interpretations.

A rock basin occupied the site of the present depression in preglacial times.

With the melting of the ice till was distributed unevenly over the floor and the slopes of this basin.

Water from the melting ice and from the sources which supplied Lake Albany filled the basin and merged it with that lake.

Deposits of clay and afterward of sands, made widely in Lake Albany, filled in the basin and for the time being obliterated it.

When Lake Albany began to subside powerful currents of water entering from the Ballston channel cut into the deposits.

The erosion of the deposits thus initiated continued *pari passu* with the subsidence of Lake Albany and resulted in the present topography and the exposures of materials on the slopes and floor of the depression as above described.

An incident of the last stage was the deposition of eroded and

transported materials (sand, gravel and small cobbles) in places on the surface of the previously eroded clays, as seen in the section above described.

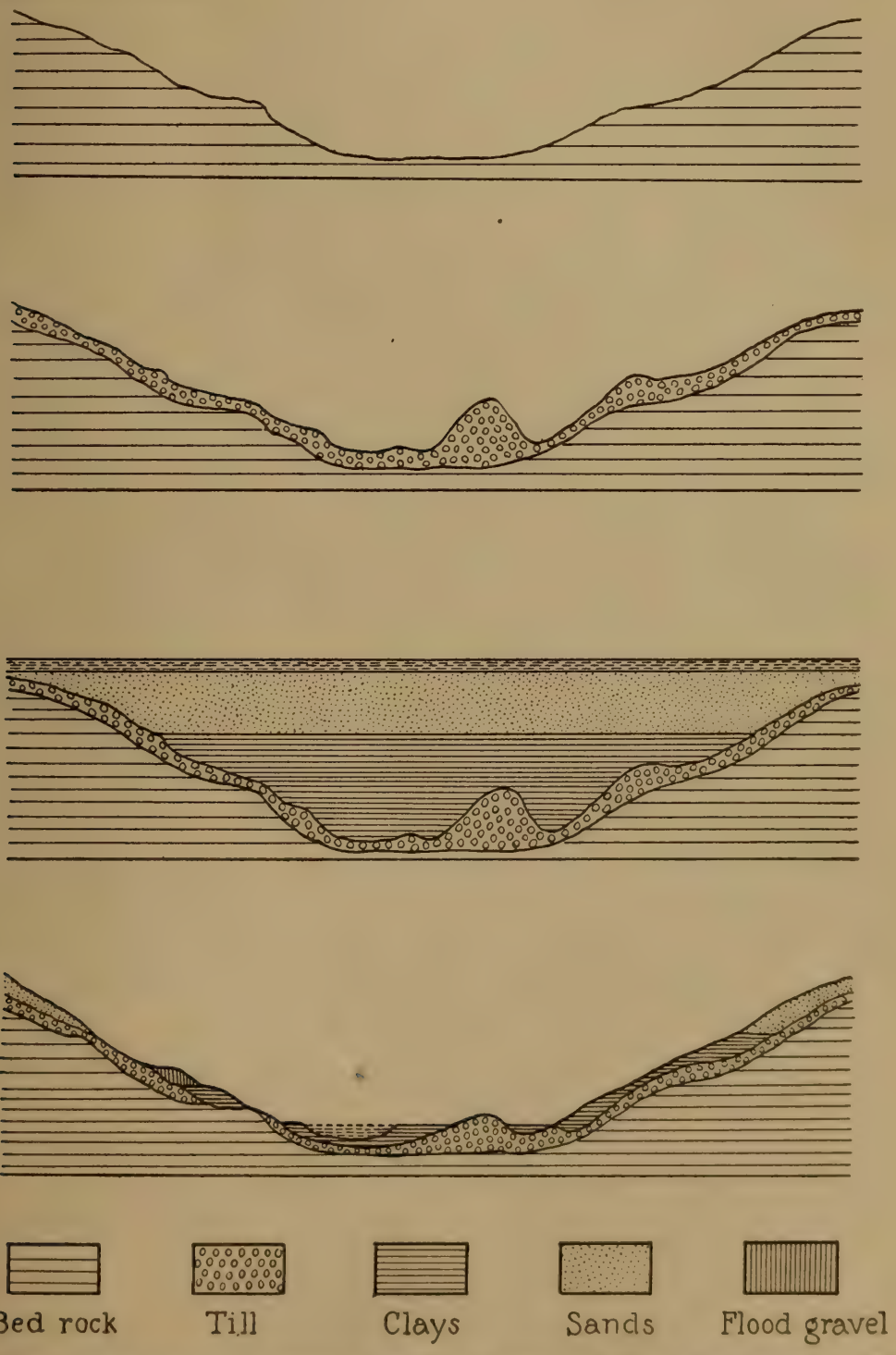

Fig. 3 Diagrams showing successive stages in the formation of Round lake depression. The first diagram shows the depression as formed prior to the glacial epoch; the second diagram shows the conditions after the melting of the ice when glacial till had been deposited on the floor and slopes of the depression; the third diagram shows the conditions when Lake Albany was at its height, clays and sands having been deposited, filling the depression; the fourth diagram shows present conditions as resulting from erosion and the deposition of flood gravel.

ECONOMIC VALUES OF THE LAKE ALBANY DEPOSITS

Molding sands. Sands of the requisite qualities for use as molding sands appear to be a widely distributed constituent of these lake deposits. They are obtained at present in the localities of the following shipping stations: near South Schenectady, Carman (on New York Central & Hudson River Railroad, east of Schenectady), Niskayuna, Dunsbach Ferry, Elnora, Usher, Round Lake.

At the South Schenectady locality about 40 acres of farm land have been here worked over and the company holds rights to about an equal additional area. The molding sand occurs in a layer underneath the surface soil at a depth of about one foot. The thickness of the layer is variable, running from a foot or less to three or four feet. In gathering the sand the surface soil is first removed; the molding sand is then directly loaded into carts and hauled to the car.

The sand is very fine grained, slightly plastic when wet and of yellowish brown color. A microscopic examination of the sand was made and it was found to correspond closely with the molding sand from Albany county described by Dr G. P. Merrill.[1] He states: "the Selkirk molding sand is of a yellow brown color showing under the microscope angular and irregular rounded particles rarely more than .25 mm in diameter, interspersed with finely pulverulent matter which can only be designated as clay. The yellow brown color of the sand is due to the thin film of iron oxid which coats the larger granules. When this film is removed by treatment with dilute hydrochloric acid, the constituent materials are readily recognized as consisting mainly of quartz and feldspar fragments (both orthoclase and plagioclase variety), occasional granules of magnetic iron oxid, and irregularly outlined scales of kaolin together with dustlike material too finely comminuted for accurate determination."

Theory of the secondary origin of molding sands. In their present occurrence the molding sands do not form a stratum but a surface layer of variable but limited thickness. This layer follows the irregularities of the surface, rising and falling with the surface elevations and depressions. In the Schenectady locality there is a marked unevenness of surface, the difference in elevation of different portions of the area being at least 30 feet. It appears to be a necessary inference from this that surface conditions are a determining cause in the origin of the layer of molding sands. In

[1] U. S. Nat. Mus. Report, 1899, p.476, 477.

dry seasons of the year when the surface soil has been largely deprived of water by evaporation, an upward movement of the ground water by capillarity takes place. If the ascending ground water carries iron in solution the iron may be oxidized and precipitated as it approaches the surface. In this way the film of iron oxid coating the particles of sand is formed. The porosity of sand, admitting air to a considerable depth below the surface and at the same time favoring evaporation, facilitates the process. In addition to the iron it is probable that small particles of clay are carried upward by the moving ground waters and are fixed through cementation by the iron oxid. These processes continue from season to season through a long period of years, the layers of molding sand being periodically added to at the bottom until it attains such a thickness that surface influences no longer penetrate it.

Sands for making sand-lime bricks. The Lake Albany deposits furnish sands which are adapted for use in the manufacture of sand-lime bricks. This industry has recently been established in the vicinity of Schenectady. There are two plants for making the bricks on the line of the Delaware & Hudson railroad between Schenectady and South Schenectady. At one of the plants the sand selected for this purpose was a somewhat coarse, sharp-grained sand of gray color. It was evidently a water-sorted sand, as it was evenly stratified and occurred in a pocket, surrounded by sands of different color and texture. At the other plant the sand used was less distinctive, being of the color and texture common to the mass of sands in that locality. At this plant the sand was first sifted to remove gravel.

Sand for making cement blocks. This industry has recently been developed to a considerable extent in the vicinity of Schenectady. There are a large number of small plants and as the apparatus used is simple it is readily moved from place to place. The sands selected for this purpose are the sharp or angular grained sands that occur in pockets as above described.

Brick clays. Though probably belonging to a later geological stage than the Lake Albany deposits described above, mention may here be made of a deposit of Pleistocene clays which is used for making red brick. The bed is located about half a mile from the highway bridge which crosses the Mohawk below Schenectady and near the Delaware & Hudson railroad tracks. The clays are yellowish and bluish in color, the colors showing in the layered arrangement of the materials. They are of firm, compact texture. The

bed is overlaid by a thickness of one or two feet of sand or sandy clay which is mixed with the stiff clays in proportions proper for the purpse of making bricks. The areal extent of this deposit of clays is said to be about 25 acres.

LAKE ALPLAUS DEPOSITS

The region of country traversed by Alplaus kill presents striking topographic features. At High Mills the creek enters a rocky gorge from which, after a descent of 40 feet in the course of a mile, it emerges on the floor of the Ballston channel. West of High Mills on either side of the creek are deposits of morainic character continuous with the morainic hills of the Burnt Hills district, already described. Farther to the west the creek lies in a broad valley bounded on either side by an extensive, nearly level area having an elevation of 420 feet. The materials of this area are stratified clays and sands of evident lacustrine origin. To the body of glacial waters in which these deposits were laid down I have given the name of Alplaus lake.

A section of the deposits is shown where the road crosses a branch of the Alplaus kill about one mile west of High Mills as follows: At the base about 10 feet of blue boulder clay with gravel; then 4 feet of dark evenly stratified clays overlaid by about 2 feet of yellowish clays, evenly stratified; then, at the top, 3 feet of sand and gravel. The sand continues as the surface soil in the adjoining fields attaining a level 10 feet higher than the top of the section. Farther to the west the deposits are of somewhat coarser materials. In many places fine gravels occur, as along the road that runs northerly to Charlton village.

The conditions under which Lake Alplaus was formed and the subsequent events resulting in the present topography are clearly deducible from the above data.

With the melting of the ice sheet a mass of debris was heaped up in the Burnt Hills district, forming morainic hills with an elevation of upwards of 420 feet.

The belt of morainic materials lay across the floor of the deepest portion of the Glenville rock basin in the locality west of High Mills.

Glacial waters became ponded back of the moraine dam, forming a lake. In this lake sediments were deposited; at first from streams derived from the melting ice and later from Alplaus creek, draining

Postglacial gorge of Alplaus creek, south of High Mills

an extensive land surface. These deposits filled the lake up to the level of 420 feet.

The overflow waters of the lake followed lines of depression across the belt of moraine forming the dam. Gradually, through difference in rate of erosion a single outlet stream was formed and began to cut out the gorge east of High Mills. At the same time the lake was drained leaving the deposits in the form of a plain, 420 feet in elevation.

Alplaus creek and its tributaries, by downward cutting and meandering, have since formed broad and deep valleys in the deposits; while below High Mills the gorge with vertical walls of rock in places 60 feet high, has been eroded out.

MODIFIED TILL

The surface materials thus far described, namely, the unmodified till and the deposits made in Lakes Albany and Alplaus, cover about five-sixths of the area of the Schenectady quadrangle. Of the remaining area much the larger part is covered by glacial till which has undergone more or less extensive modifications since it was left by the melting of the ice. The modifications were due either (1) to additions of other materials, at first generally covering and afterward becoming more or less intermixed with the till, or (2) to the removal by erosion of a portion of the materials of the till, altering its surface features and to some extent its composition.

Glacial till more or less covered and mingled with marginal lake deposits or with glacio-fluviatile deposits or with wind-blown sands. In the work of mapping it was found that in many localities it was difficult to fix the marginal boundary lines for the lacustrine deposits, since the sands of the latter graded into the materials of the adjoining areas of till. This is interpreted as due to marginal lake deposits having originally overlapped the till and subsequently become mixed with it. Such intermixing would result from the cultivation of the land, the tunneling of the soil by burrowing animals and the roots of trees, and to some extent by the processes of weathering. Accordingly for the sake of accuracy it seemed best in the localities in question to indicate a marginal area or belt separating the undoubted lake deposits from the evidently unmodified till. This expedient did not, however, always render the task of fixing the lines an easy one and in some localities they have been drawn somewhat arbitrarily.

A like difficulty was experienced where areas of till lie on the side of the sand regions toward which the prevailing winds (northwest) blow. Sands blown by the wind have been deposited on the till and subsequently intermixed with it in the ways above described. On the upland slopes east of Schenectady this condition is developed over a considerable area. This has been mapped as modified till.

A third condition is that produced by the spreading of materials (mostly sands) over the till by glacio-fluviatile waters. The glacial streams derived from the melting ice lingering on the uplands of the northern part of the sheet carried the finer materials of the debris derived from the glacier to lower levels. It was from this source that materials deposited as sediments in Lake Alplaus were largely derived. But, apparently, before the Alplaus area had become freed

of ice, glacial waters swept across the floor of the Glenville basin, along the foot of the Glenville hills, and southward to the Mohawk channel. These waters deposited sands over an already till-covered area, thus forming the surface materials of mixed composition — sands or clayey sands of loose texture, with cobbles and boulders — of the southeastern portion of the town of Glenville.

Glacial till more or less washed and eroded by powerful currents of water, boulders mostly of large size. The vicinity of East Line in the northern part of the sheet exhibits in its typical development the glacial till as modified by powerful currents of water. The surface of the country is marked by a general evenness or absence of hilly features. It is thickly strewn with boulders and large cobbles. The soil or mantle of materials covering the bedrock, is generally thin, with frequent exposures and outcrops of rock. The soil is generally clayey, evidently consisting partly of till clays and partly of residual clays from local rock detritus.

Features and materials of like description mark the several watercourses that radiate from the East Line vicinity. In the valley of Drummond creek, flowing to the northeast, and in the valley and on the slopes of Mourning kill, flowing north, and of Anthony kill, flowing southeast across the Round lake depression, evidences of the washing and eroding effects of moving flooded waters are definite and unmistakable. In the last named valley, in the section extending from near East Line to Round lake, the floor and lower slopes have been stripped of all the till except large boulders which now lie on the surface of rock. On the floor and slopes of the Round lake depression the till shows eroded and water-swept surface features.

The three glacial watercourses just noticed were branches of a more general watercourse occupying the Ballston channel. The evidences are of the same nature as already described. The region north of Ballston lake to East Line and on either side of the northern end of Ballston lake is strewn with boulders and shows water-swept surface features. The floor of the channel farther to the south, near the head of the lake, is neither eroded till or worn rock surface, partly covered with rock detritus. Similar features characterize the southern end of the channel except that on its western slope erosion took effect in the Lake Albany deposits and not to the extent to expose the underlying till.

The inference to be drawn from these facts is plain. A flood of waters once swept northward through Ballston channel, dividing in the vicinity of East Line into three currents which pursued the several courses described above. The time in glacial history when this took place was subsequent to the general disappearance of the ice and also subsequent to the stage of maximum development of Lake Albany. For these currents eroded out the Lake Albany deposits that filled at least the southern end of the Ballston channel and the deposits that filled the Round lake basin and then cut into the underlying till and, in places, through the till to bedrock.

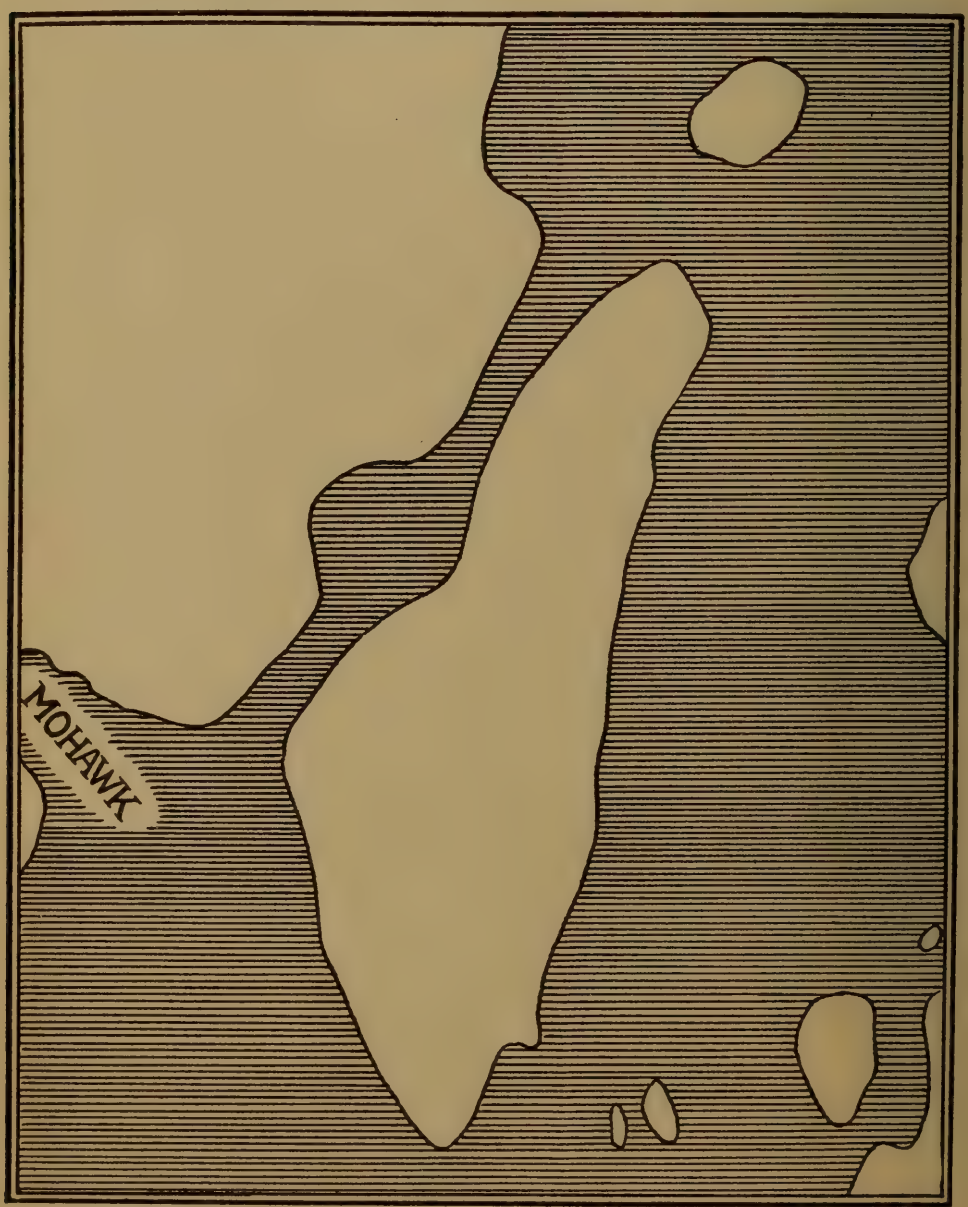

Fig. 4 Sketch map showing the distribution of land and water on the area of the Schenectady quadrangle when Lake Albany was at its height. Shaded part denotes waters of Lake Albany

Glacial till washed and eroded by powerful currents of water. In Ballston channel, east of the northern end of Ballston lake.

The flood which coursed northward through the Ballston channel was a part of the Mohawk flood when the stream was the outlet of Lake Iroquois. There were several conditions which determined this diversion of the Mohawk waters into the channel. (1) The subsidence of the waters of Lake Albany. When Lake Albany was at its fullest development, the Mohawk discharged into the body of the lake near Schenectady, its waters spreading widely into the lake as shown by the delta deposits previously described. Later when the lake began to subside and the delta emerged as land surface the river became gradually confined to the Mohawk channel and flowed in great volume and with high velocity in that portion of the channel which now forms the basin near Schenectady. (2) But the preglacial channel of the Mohawk from near Schenectady eastward had been filled by deposits and the waters now cut off from the old outlet sought the lowest levels of discharge left open to them under the new conditions. (3) At Aqueduct and eastward, where the river now occupies a gorge, a barrier of rock then existed. The present elevation of the rock surface on the north side of the river east of Rexford Flats is the same (according to the contour lines) as the elevation of the bluff bounding the Mohawk basin on the south, near Schenectady. This elevation may be taken at 350 feet. The surface slope of the rocks in that region is toward the south and a thick mass of till overlies the rocks south of the river. These conditions show that when Lake Albany had so subsided that the Mohawk waters flowed within the Schenectady basin, an overflow took place across the Aqueduct barrier and a spillway became established there, the waters entering Lake Albany near Vischer Ferry after flowing over the surface of the rocks and for a distance of some three miles. (4) The Aqueduct barrier acted as a dam against a great rush of waters and while the spillway just described was forming, a second place of discharge from the basin had become established. This was through the Ballston channel.

The southern end of this channel had been filled with sediments deposited in that portion of Lake Albany now indicated by the small sand plain east of East Glenville. The Ballston lake section of the channel had probably remained open. There is no clear evidence that it received Lake Albany deposits at any time. Woodworth,[1] as already quoted, has suggested that during the Mohawk delta stage "the ice sheet lay over this region (Ballston lake) while

[1]Ancient Water Levels. Mus. Bul. 84. 1905. p. 76

these clays were deposited on the east and south." It is true that Lake Albany deposits occur north of Ballston lake (crossed by the northern edge of the sheet). These deposits, however, represent deltas made by currents flowing from the north. They are thickest at the edge of the sheet and thin out toward the south, indicating that the currents dropped their loads not much south of the present boundary lines of these deposits.

There was, therefore, little to obstruct the northward flow of strong currents through the Ballston channel. The Lake Albany deposits in the southern end offered at least no more resistance than

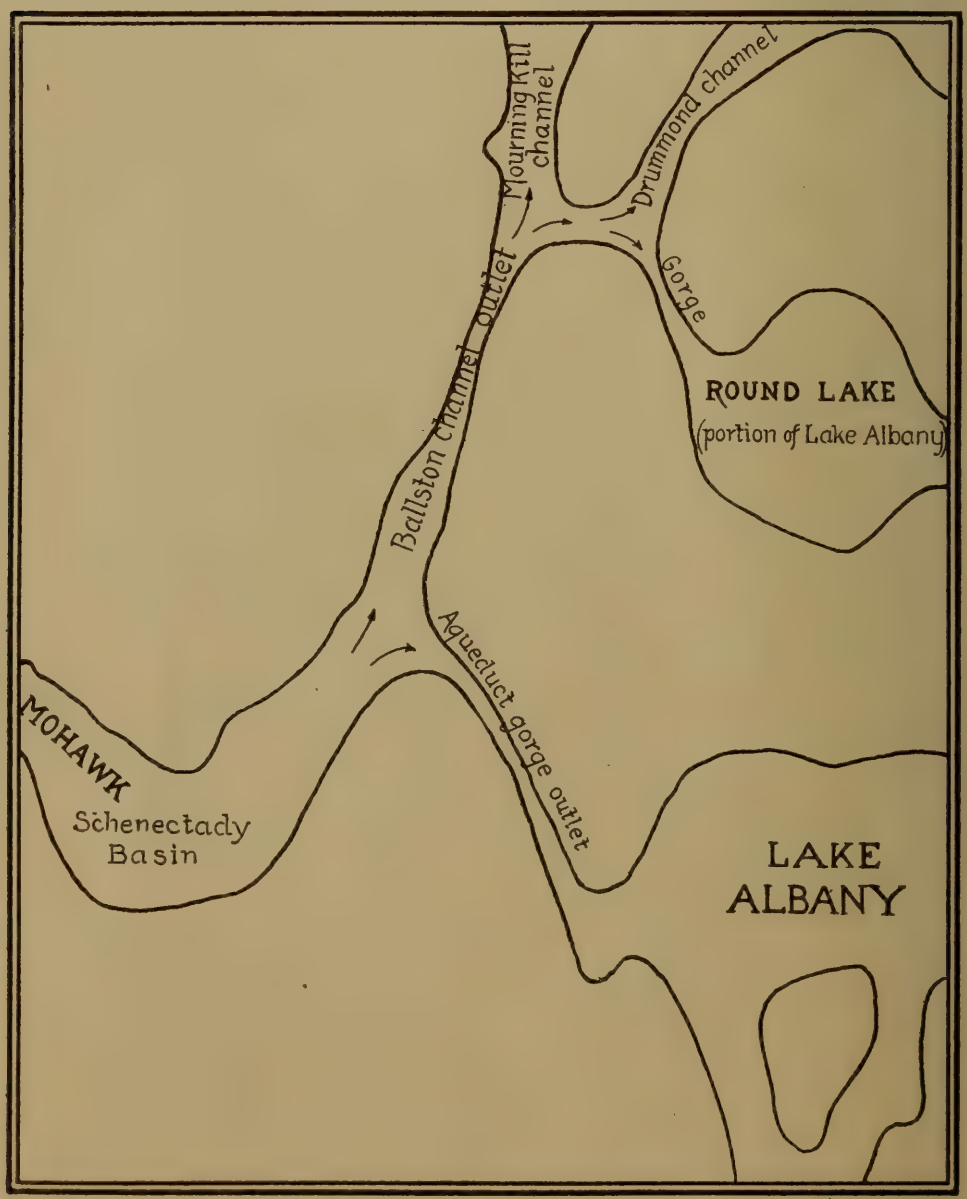

Fig. 5 Sketch map showing the distribution of land and water on the area of the Schenectady quadrangle when Lake Albany had subsided to the level of about 320 feet

the barrier of till, or till and rock, in the Aqueduct region. The dammed up waters, everywhere pressing against the slopes of the basin, gradually cut through these deposits and coursing northward flowed over the area in the vicinity of East Line, discharging into Lake Albany in that quarter.

These two exits of the Mohawk flood waters from the basin near Schenectady to Lake Albany continued for a considerable period. During this period the waters of Lake Albany further subsided. The three watercourses radiating from the East Line locality were established and the erosion of the Lake Albany sediments now represented by their channels, in their broader aspects, including the Round lake depression, took place.

At the same time the spillway in the Aqueduct region had deepened in that portion of its bed which was least resistant to erosion and had thus gradually acquired the character of a gorge. Its capacity, however, had not been increased to the extent that it afforded an exit for the entire volume of waters that the Mohawk poured into the basin, so that the excess of waters, above the capacity of the nascent gorge, continued to be diverted into the Ballston channel.

While the condition just named must have been for a long time a factor in the maintenance of the two contemporaneous outlets, it does not appear that it was a condition necessary to this end. For if we suppose that the rate of subsidence of Lake Albany was not greater than the rate of lowering of the channel of the two streams by erosion then the two outlets must have persisted. Even when the Aqueduct gorge, in the process of its gradual enlargement, acquired a capacity sufficient to contain the entire volume of Mohawk waters, the Ballston channel remained open as long as its bed was maintained at the same level as that of the Aqueduct channel. As long as, due to the subsidence of Lake Albany, an impetus was given to the flow of the waters in the two channels and as long as this flow kept the beds of the two channels eroded to the same level, both outlets must have persisted.

At length the time came when the Ballston channel currents were unable to maintain this equality of erosive effects. The greater length of bed to be deepened as compared with its rival gave the advantage to the latter. As soon as a slight difference in depth of bed was established in favor of the Aqueduct passage, the waters of the Ballston channel began to be drawn off. The divide in the channel emerged as land surface and the present system of drainage was initiated.

MOHAWK FLOOD DEPOSITS OF GLACIAL AGE

The broad basin of the Mohawk, west of Schenectady, is largely filled with deposits of gravel and sand. These deposits appear as the surface materials of the extensive depressed area, north of Scotia, crossed by the trunk-line railways. Farther to the south, along the river, gravels underlie the alluvium, as is shown where, on the shores of the islands, the alluvium has been swept off. The bed of gravel has been cut into by the river near the western edge of the sheet exposing a thickness of about 50 feet. The materials as here exhibited consist of cobbles of considerable size, generally smoothly worn, mixed with coarse sand and clay. The clay, or clay and lime, constituent to some extent acts as a cementing substance and masses of considerable thickness, appearing somewhat stratumlike in arrangement, are of conglomerate composition. Huge fragments of conglomerate have become detached and fallen to the base of the bluff.

The wells from which the public water supply of the city of Schenectady is obtained are excavations in this bed of gravel. They are located just south of the river at a point about one mile west of the western extremity of Van Slyck island. There are three wells, varying in depth from 42 to 44 feet. The deepest one is farthest to the east and is excavated entirely in gravel. The other two penetrate the bed of gravel and have their bottoms on a compact clay of dark bluish color.

There is an evident gradation from the coarser gravels in the western portion of the area referred to above to finer gravels and coarse sands farther to the east, passing to sands in the immediate vicinity of Scotia. Northwest of Scotia and extending as far as Alplaus the surface materials are mainly coarse sands and gravels.

North of the tracks of the New York Central & Hudson River Railroad there is a depression which was evidently at one time a watercourse. The soil here is clayey in composition and is believed to represent a deposit of alluvial origin. Another narrow area of clay of similar composition occurs farther to the east, extending toward Alplaus and bordering the modern river alluvium. In mapping it was thought best to distinguish between these, although the line of demarkation could be drawn only somewhat arbitrarily.

The bed of coarse gravels above described lying northwest of Scotia and extending to the edge of the sheet and beyond is interpreted as a deposit made by the Mohawk in the flooded or Iroquois stage of that river. It represents the heavy materials which were

Glacial flood gravels northwest of Scotia, cut by the Mohawk river

Looking across the Mohawk basin west of Schenectady

carried or pushed along by swift currents of water and which were deposited where the currents entered the static waters of Lake Albany. The less coarse materials were carried farther on and deposited in the order of their fineness. The fine clay and sand sediments were borne far out into the lake, building a great delta, as already described.

When Lake Albany had subsided to the extent that the Mohawk currents were held within the present boundaries of the basin the deposits were powerfully affected by the increased erosive force of the currents. The surface of the mass of coarse gravels heaped up in the western portion of the basin was swept by the swift currents and the finer constituents were picked up and carried on toward the Aqueduct spillway and (as soon as opened) the Ballston channel outlet. These sediments, however, owing to the damming effect of the Aqueduct barrier, were to a large extent redeposited, especially along the northern slope of the valley, thus giving rise to the coarse sands and fine gravels which constitute the surface materials of a somewhat broad area extending from north of Scotia to Alplaus. At a later date when the gorge at Aqueduct had been cut to the 300 foot level, the surface of the coarse gravel bed emerged, forming an island where the highest part of the gravel area northwest of Scotia now appears. This island increased in extent with the further lowering of the waters and the river thus became divided into two streams, one between the island and the slope of the hills to the north, the other approximately where the present river channel is located. As the northern stream gradually shallowed it began to deposit fine sediments and when finally the river abandoned this channel, the sediments remained as the soil of alluvial character described above.

DEPOSITS FROM FLOATING ICE

At the time of its flooded condition, especially in the early stages, the Mohawk waters doubtless transported numerous masses of floating ice. As these blocks melted, and where they became stranded and subsequently melted, the debris inclosed in them was dropped and added to the deposits already made from the waters. In this way the occasional boulders found buried in sands or mingled with gravels may be accounted for. Interesting examples of these are found in several localities. There is evidence that an ice block was stranded a short distance north of Scotia. A kettle hole (shown by a depression contour line on the topographic sheet) has

a number of boulders of considerable size lying on its bottom. They are the more noticeable as occurring in the midst of an area of sand and fine gravel.

Boulders inclosed in sand, and dissociated from the underlying till, occur in the fields where molding sand is obtained southeast of South Schenectady. Also in the deep cut made in grading the new railway line to South Schenectady a large boulder imbedded in sand is exposed.

RECENT DEPOSITS

The deposits belonging to the recent epoch or period that has elapsed since the final subsidence and disappearance of glacial waters are (1) the alluvium laid down on the flood plains of the Mohawk river and the larger creeks and (2) the wind-blown sands of the sand plain areas. Mention may also be made of the peaty accumulations of swamps, or partially drained areas formerly lakes.

STREAM ALLUVIUMS

The alluvial deposit in the basin west of Schenectady is somewhat notable both for areal extent and for thickness. Some four or five square miles of valley lands, including the several large islands in the river, are composed of soils of alluvial origin. It is said that it was the fertility of these soils of the "great flats" that determined the original settlement of Schenectady.

The lower portion of the basin is still an area of sedimentation. This is shown not only by the overflow of the river on the flood plain at times (high water), but also by the steady growth of the islands west of the Schenectady-Scotia bridge at their lower (downstream) ends, and the silting up of the channels between them. It is also interesting to note that two new islands have been formed in recent years farther down the river, about half a mile west of the mouth of Alplaus kill. On the other hand, at the western end of the basin the alluvium is to some extent being swept away by the river currents, as is shown by the fact that the underlying gravel has in places been laid bare.

Another extensive alluvial deposit made by the Mohawk occurs farther to the east below Vischer Ferry. Here the river, abandoning the rock-bottomed channel which begins at Aqueduct, enters the territory of Lake Albany deposits. The stream has cut through the sands and clays and swept out a broad basin the floor of which consists mainly of till, overlaid, in the flood-plain area, with alluvium.

WIND-BLOWN SANDS

The regions of Lake Albany deposits where the surface materials consist mainly of sand show the effects of the drifting and heaping of sands by the winds. Some portions of these areas present a highly distinctive sand-dune topography. This is conspicuously the case in the Schenectady-Albany sand plain. The dunes are for the

most part in the form of ridges with axes parallel to the direction of the prevailing wind that is, northwest-southeast. These dune features are brought out strikingly by the contour lines of the sheet in the portion of the plain crossed by the New York Central & Hudson River Railroad tracks, southeast of Schenectady.

The extent to which sands have been shifted by wind agency is clearly indicated on this plain. The western portion is nearly level and its soil has some clay mixed with the sand. It bears the appearance of a wind-denuded plain, from which the surface sands have been partially stripped leaving the underlying clays. To the east of this level area lies the highly irregular surface, marked by ridges and hillocks of sand. The highest dunes attain an elevation of 400 feet or 60 feet above the level of the denuded portion of the plain. This does not represent, however, the full extent to which the sands have been lifted, as farther to the east where the hills of till rise to the height of 500 feet, the country is more or less overspread with wind-laid sands.

In the sand region of the eastern portion of the sheet lying between the Mohawk valley and the Round lake depression there are extensive areas marked by the effects of wind agency. The country around Clifton Park is especially characterized by hills and hollows of sand. There is no evident regularity to the forms of the dunes, indicating that winds blowing from different directions have had part in their formation. Recent effects of the wind in modifying existing surface features are noticeable.

Plate 8

Showing the topography of the sand plain region southeast of Schenectady where the sands have been blown by the winds, forming dunes

A portion of the sand plain region which has undergone denudation by the winds; located east of South Schenectady

REVIEW AND SUMMARY

The Pleistocene history of the area of the Schenectady quadrangle begins with that condition of glaciation which produced the striae now observable on the surface of the bedrock. We start, then, with the conception of a sheet of ice overspreading the country and moving in a general direction of some 30 degrees west of south. The number of localities where striae were observed is insufficient to determine differential movements due to the adjustment of the flow of the ice to local irregularities of surface. A comparison with similar observations for adjoining territory would also be necessary to determine whether the direction of movement was influenced by the regional topography which, as suggested by Chamberlain,[1] caused a westward movement of ice in the eastern portion of the Mohawk valley. It may be noted, however, that at the western edge of the sheet striae showing a direction of 57 degrees west of south were observed in one locality.

With the change to climatic conditions that resulted in the general retreat of the ice sheet to the north, we conceive that the southern portion of the area was first freed of ice. Its lower altitude as compared with the northern portion of the sheet strengthens the probability of this inference. The withdrawing ice sheet left in its wake the materials of the ground moraine together with the debris dropped by the melting ice, forming the sheet of till that now overlies the bedrock.

As the channel of the Mohawk became uncovered it seems probable that glacial waters filled the rock depression underlying the present basin west of Schenectady. Rocks lie at a considerable, though unknown, depth below the present surface of the basin; we also lack knowledge of the present extent of this rock basin toward the south. We may, however, with considerable confidence assume the accumulation of glacial waters in this locality before the Mohawk valley to the west was opened. It is likewise probable that the rock basin below Vischer Ferry filled in with waters derived from the melting ice.

How soon after the withdrawal of the ice from the southern portion of the sheet the Lake Albany waters spread over the bared area could be determined only by a study of the general conditions involved in the origin and development of Lake Albany. It is even

[1] U. S. Geol. Survey, 3d An. Report, p.361–65.

possible that the two local accumulations of glacial waters just referred to were parts of that general body of water.

If, however, the lower Mohawk valley became open prior to the time when Lake Albany had developed to the extent that it covered the general region from the Mohawk valley near Schenectady to the Hudson, then the Mohawk waters found an outlet to the Hudson channel at the lowest level left open by a topography modified by glacial drift. It is possible that at this time the preglacial channel of the Mohawk still afforded this passage.

As the ice sheet receded farther to the north, uncovering the region of the Glenville basin, glacio-fluviatile waters swept in considerable volume across the floor of that depression, bearing sands to the area southward.

In the region of Burnt Hills there was a temporary halt in the recession of the ice sheet, giving rise to morainic accumulations. Behind these accumulations glacial waters became ponded, thus originating Lake Alplaus.

We pass then to the stage when Lake Albany had reached the development evinced by the clays and sands of the plain region between Schenectady and Albany. These deposits are likewise the witness of a flooded condition of the Mohawk which we correlate with the Iroquois stage of that river. Where the flooded river issued into the lake, somewhat west of the western edge of the Schenectady sheet, it dropped the coarser materials of its load, building a bed of gravel into the lake; the finer sediments were carried farther out into Lake Albany, building a delta. For a long time these finer sediments consisted mainly of clays derived from the shale rocks which predominate in the drainage basin of the river. Later, when the southern slopes of the Adirondack region became freed of ice, the Mohawk received from its tributaries from the north the sands derived from the Precambric rocks and these were deposited in Lake Albany overlying the clays.

It was perhaps during this time that the preglacial channel of the Mohawk from near Schenectady eastward was filled up by sediments. The alternative view is that it had been filled at an earlier time by glacial debris, or drift.

At some time after the ice in its retreat to the north had passed beyond the northern edge of the area of the Schenectady sheet, the waters of Lake Albany covered all parts of the area, the present elevation of which is from about 350 feet in the southern part to 380 feet in the northern part. Besides the Mohawk delta, above

described, sediments borne by currents from the north were deposited in the lake, forming the clays and sands of the eastern and northern portions of the sheet. There is evidence that a tongue of ice lingered in the depression of the Ballston channel, thus preventing the accumulation of sediments in the northern portion of this depression.

The time came when Lake Albany waters began to subside The delta southeast of Schenectady emerged as land surface and the Mohawk currents became confined within a channel conforming with the basin near Schenectady. For a time the flooded waters may have found a passage to the east near South Schenectady in the course marked by the present valley of the Poentic kill. But as the divide between Poentic kill and Normans kill is now about 350 feet elevation and allowance must be made for postglacial erosion, it is evident that a spillway was found across the rocks below Aqueduct and the flow of the currents was established in this direction. The rush of waters, impeded by the Aqueduct barrier, forced an entrance into Ballston channel, eroding the sands deposited in that portion of Lake Albany which occupied the southern end of the channel. The northward moving currents emerged from the Ballston channel near East Line, there discharging into Lake Albany. As the lake further subsided the currents established three watercourses: two northerly, initiating the present valleys of Mourning kill and Drummond creek and one southeasterly, initiating the valley of Anthony kill. The current pursuing the last named course eventually swept away the sands and clays in the Round lake locality resulting at length in the present depression in that region.

The two outlet streams from the Mohawk basin to Lake Albany were maintained as long as through erosion their beds were kept at the same level. This equality of erosive effects was probably determined by the circumstance that the rate of subsidence of Lake Albany was no greater than the rate of lowering of the beds of the two streams by erosion. At length, however, owing to the greater extent of bed of the Ballston stream, it failed to deepen its channel as rapidly as its rival and its waters were drawn off in favor of the Aqueduct course of the Mohawk.

The present conditions of drainage having thus been initiated, the Mohawk gorge below Aqueduct, the Alplaus gorge below High Mills and the gorge of Anthony kill from near East Line to Round Lake have since been developed. Probably the greater part of the

erosion resulting in these gorges was the work of the flooded waters of the late glacial and early postglacial times; but the process has continued during the present epoch and is still in progress.

With the gradual deepening of the Aqueduct gorge the Mohawk waters, sweeping in a great half circle, cut into the western edge of the Lake Albany deposits forming the basin near Schenectady. At the same time the waters, as they issued from the gorge, spreading in their course, swept away the sands and clays in their path, forming the basin east of Vischer Ferry. In the recent epoch the surfaces of these basins have been overlaid with alluvium.

The plains left by the subsiding Lake Albany waters were early swept by strong winds which, over extensive areas, lifted the surface sands, transporting them mainly eastward. Thus were formed, on the one hand, wind-denuded and leveled tracts and, on the other, the regions marked by hills and ridges of wind-blown sands.

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BULLETIN 154
SCHENECTADY QUADRANGLE

Geology by J. H. Stoller, 1910.

LEGEND

Rock outcrops along highways

Glacial scratches

Swamps or partially drained areas; mainly vegetable debris.

Modern river and stream alluvium.

Dunes of sand well defined.

Wind-blown sands more or less heaped into dunes.

Mohawk flood deposits of glacial age, mainly clays of alluvial origin

Mohawk flood deposits of glacial age; coarse gravels (northwest of Scotia) grading to fine gravels and sands.

Rocks formerly laid bare by powerful currents of water; now mostly thinly covered by rock detritus or residual clays; boulders large when present.

Glacial till more or less washed and eroded by powerful currents of water; boulders mostly of large size.

Glacial till more or less covered and mingled with marginal lake deposits or with glacio-fluviatile deposits or with wind-blown sands.

Clays or sandy clays deposited in Lake Alplaus; stratified.

Clays or sandy clays, grading into overlying sands; stratified; deposits made in Lake Albany.

Unmodified glacial till.

Scale 1/62500 — 1 Mile — 1 Kilometer

Contour interval 20 feet

Datum is mean sea level

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